ENGG7302
Advanced Computational Techniques in Engineering
Class Quiz – Optimization
19th April, 2007.

Name: Student ID:

Instructions: Provide your answers to all questions on this question sheet. Questions are worth the number of marks indicated. 13 questions. Total marks available: 20.

Indicate whether each of the following statements is true (T) or false (F) (1 mark each):

1. In an optimization problem, the number of equality constraints can be larger than the number of problem variables.

2. In an optimization problem, the number of inequality constraints can be larger than the number of problem variables.

3. In a constrained optimization problem, the gradient at the global optimum must be equal to 0.

4. In the Nelder-Mead simplex algorithm (given an optimization problem of dimensionality d), a population of points of pre-determined size is used to conduct the search.

5. The Nelder-Mead simplex algorithm evaluates the objective function a fixed number of times during each iteration of the search.

6. Quasi-Newton algorithms require the ability to evaluate the objective function and its partial first derivatives but do not require calculation of higher-order derivatives.

Indicate the correct answer(s) (2 marks each):

7. Which of the following algorithms (circle as many as applicable) provides an explicit mechanism for avoiding previously explored solutions in the search space:

   a) Genetic Algorithms
   b) Particle Swarm
   c) Tabu Search
   d) Ant colony optimization

8. Classify each of the following algorithms as being trajectory-based (T) or population-based (P):

   a) Blind random search
   b) Nelder-Mead simplex algorithm
   c) Conjugate gradient
   d) Particle swarm optimization

Provide a short answer (e.g. one or two sentences) for each of the following questions (2 marks each):

9. Given a candidate solution to an inequality-constrained optimization problem, what is the difference between an active constraint and an inactive constraint?

10. What is the purpose of the mutation operator in an evolutionary algorithm?

11. Given two individual bitstrings `b1 = 00101101` and `b2=11101010` in the population of a genetic algorithm, illustrate the effect of performing a 1-point crossover operation and the resulting offspring bitstrings.

12. Describe the behaviour of simulated annealing as the temperature parameter T becomes very large.

13. Describe the behaviour of simulated annealing as the temperature parameter T tends towards zero.